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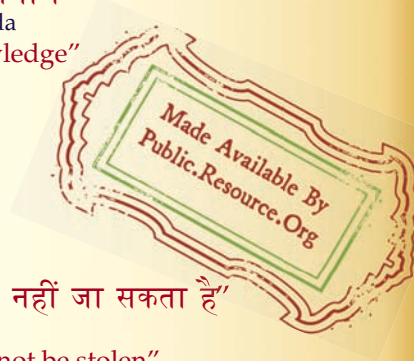
IS 4573 (1982): Specification for Power Driven Mobile Cranes [MED 14: Cranes, Lifting Chains and Related Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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**IS : 4573 - 1982**

**(Reaffirmed 2000)**

**Edition 2.1**

**(1989-09)**

*Indian Standard*  
SPECIFICATION FOR  
POWER DRIVEN MOBILE CRANES  
( *First Revision* )

(Incorporating Amendment No. 1)

UDC 621.873.2/.3

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**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

**Price Group 8**

# *Indian Standard*

## SPECIFICATION FOR POWER DRIVEN MOBILE CRANES

### ( *First Revision* )

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*Indian Standard*  
SPECIFICATION FOR  
POWER DRIVEN MOBILE CRANES  
( *First Revision* )

**0. FOREWORD**

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 10 December 1982, after the draft finalized by the Cranes and Allied Appliances Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** This standard covers mechanical, electrical, hydraulic and pneumatic portions related to design, manufacture, erection and testing of mobile cranes. Structural design of all types of cranes and hoists is covered in IS : 807-1976\*.

**0.3** This standard was first published in 1968. In this revision the following major modifications have been effected:

- a) The title of the standard has been modified since the cranes covered by it are power driven,
- b) Some of the terms have been redefined and some terms have been added keeping in view the specific needs of mobile cranes,
- c) Provisions relating to stability have been rationalized keeping in view the service requirements of mobile cranes,
- d) Factors of safety for ropes have been rationalized,
- e) Provisions relating to hydraulic and pneumatic portions have been added, and
- f) Provisions relating to testing have been amended to cover for testing of mobile cranes with telescopic jibs. The test requirements now cover all forms of mobile cranes.

**0.4** All the necessary information regarding the conditions under which the crane is to be used together with the particulars laid down in Appendix A shall be supplied with the enquiry or order. The manufacturer shall supply with the tender the information in accordance with the proforma laid down in Appendix B.

**0.5** This standard makes references to other relevant Indian Standards, which are listed in Appendix C.

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\*Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists ( *first revision* ).

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**0.6** The committee kept in view the manufacturing and trade practices prevailing in the country while formulating the standard. Assistance has also been derived from the following publications:

BS : 1757-1981 Specification for power-driven mobile cranes issued by British Standards Institution ( *second revision* ).

PCSA Standard mobile power cranes and excavator equipment, Power Crane and Showel Association, No. 1-1968 USA.

**0.7** This edition 2.1 incorporates Amendment No. 1 (September 1989). Side bar indicates modification of the text as the result of incorporation of the amendment.

**0.8** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

**1.1** This standard covers power driven mobile cranes, either wheel mounted or tracked, of the following types but does not include rail-mounted cranes:

- Type 1 — Fully mobile full-slewing
- Type 2 — Fully mobile part-slewing
- Type 3 — Fully mobile non-slewing
- Type 4 — Truck mounted fully mobile full-slewing
- Type 5 — Truck mounted fully mobile part-slewing
- Type 6 — Truck mounted fully mobile non-slewing
- Type 7 — Semi-mobile types of any of the above classes
- Type 8 — Portable

## SECTION I GENERAL

### 2. DESCRIPTION OF TYPES

**2.1 Type 1 Fully Mobile Full-Slewing Cranes** — Cranes having structure capable of slewing through unlimited revolutions in either direction, able to handle loads up to the maximum for which they have been designed, and able to travel under their own power with such loads suspended at any point in their full circle of slewing.

**2.2 Type 2 Fully Mobile Part-Slewing Cranes** — Cranes similar to Type 1, but having a limited arc of slewing.

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\*Rules for rounding off numerical values ( *revised* ).



**2.3 Type 3 Fully Mobile Non-Slewing Cranes** — Cranes similar to Type 1, but having a non-slewing superstructure, and which obtained the slewing effect only by manoeuvring the complete crane by means of its steering and travelling mechanism.

**2.4 Type 4 Truck Mounted Fully Mobile Full-Slewing Cranes** — Cranes mounted on chassis with a separate drivers cab, having characteristics substantially the same as those of truck and having a separate truck engine mainly for the travel motions, the crane superstructure and handling of the load being the same as described for Type 1 cranes in 2.1.

**2.5 Type 5 Truck Mounted Fully Mobile Part-Slewing Cranes** — Cranes having chassis are described for Type 4 in 2.4, but possessing a superstructure and load handling abilities as described for Type 2 cranes in 2.2.

**2.6 Type 6 Truck Mounted Fully Mobile Non-Slewing Cranes** — Cranes having chassis as described for Type 4, but possessing a superstructure and load handling abilities as described for Type 3 cranes in 2.3.

**2.7 Type 7 Semi-Mobile Cranes of any of the Above Classes** — Cranes which substantially comply with the requirements of any of the above classes, with the exception that they require the use of outriggers to enable them to handle their designed maximum loads, or have limitations with regard to travelling with loads.

**2.8 Type 8 Portable Cranes** — Cranes which are unable to travel under their own power.

### 3. DEFINITIONS

**3.0** The definitions of terms referred in this standard are given below.

**3.1 Blocking-up Base** — The effective span of the supporting base when outriggers, jacks or blocks are used to increase stability by virtue of making contact with the ground at points further from the centre line of the crane than the normal wheels or tracks.

**3.2 Derricking** — The movement of the jib when pivoting in a vertical plane.

**3.3 Height of Lift** — The vertical distance between the floor level or datum level and the lowest point of the throat of the hook when the hook is in the highest working position.

**3.4 Hoisting** — The movement of the load (by means of a rope or chain) when being vertically raised or lowered, the jib remaining stationary.

**3.5 Jib Length** — The shortest distance between the fulcrum of the jib and the centre line of the jib head pulley.

NOTE — If jibs have a portion which extends to the rear of the pivoting joint, that portion is ignored when stating the jib length.

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**3.6 Outreach** — The horizontal distance from the centre line of the lifting hook to the nearest point on the chassis. This dimension shall be measured with the crane on level ground and with load suspended.

**3.7 Safe Working Load** — The external load lifted or handled by the crane. It includes, the mass of lifting tackles, for example, magnets, grabs, lifting beams and hook blocks, but excludes wind load and inertia forces.

**3.8 Slewing** — The movement of the jib rotating about a vertical axis.

**3.9 Tail Radius** — The maximum distance from the centre of rotation to the tail of the revolving superstructure.

**3.10 Working Radius (Radius of Load)** — The horizontal distance from the projection of the axis of rotation to the supporting surface before loading, to the centre of vertical hoist line or tackle with load applied.

## **4. IDENTIFICATION AND RADIUS-LOAD INDICATION**

**4.1** The crane shall bear one or more plaques having the following permanent inscriptions:

- a) Manufacturer's name, and
- b) The safe working load or loads and the radii appropriate thereto.

**4.2** A small plaque shall be located in a permanent place inside the cab bearing the following inscription:

- a) Manufacturer's name,
- b) Manufacturer's serial number, and
- c) Maximum safe working load at minimum radius.

**4.2.1** Other information may be furnished through manufacturer's literature.

**4.3 Indication of Load at Different Radii** — A load indicator shall be provided in full view of the driver giving the information about the radius at which the crane is derricked and the appropriate load thereof.

**4.4** A device shall be fitted to the crane, which will give an alarm to the driver when the safe working load is approached. The device should be both visible and audible. Crane shall trip if the 100 percent safe working load is exceeded.

## **5. WORKING CONDITION**

**5.1** The crane shall be regarded as under service conditions when it is handling on firm and level ground at the appropriate radius any load up to the maximum for which it has been designed, that is, when it is lifting and holding or lowering the load and/or the jib, and/or is slewing and/or travelling in any direction, while being subjected to the stresses caused by a wind pressure of 250 Pa computed as described in **5.2**.

## 5.2 Wind Effect

**5.2.1** Under service conditions the crane shall be able to withstand a steady wind pressure of 250 Pa.

**5.2.2** Under static conditions, the crane shall be capable of withstanding a steady wind pressure of 1 720 Pa (175 kgf/m<sup>2</sup>) without load. For special applications and extreme zones, the requirements of wind pressure shall be specified by the purchaser.

**5.2.3** The wind pressure under either conditions shall be calculated with form factors as given in Table 3 of IS : 807-1976\*.

## SECTION II MECHANICAL

### 6. DESIGNING OF CRANE MECHANISM

**6.1 General** — The design of component parts of the mechanism relating to each motion shall include due allowance for the effects of the duty which the mechanism will perform in service.

**6.2** The slew drive shall be designed in such a manner that loads in excess of the design capacity of the jib are not applied during acceleration and deceleration of slewing speeds.

### 7. STABILITY

**7.1 Condition of Tipping** — The machine is considered to be at the point of tipping when a balance is reached between the over-turning moment of the load and the stabilizing moment of the machine at which point addition of any further load will cause imbalance, when on a firm, level supporting surface.

**7.2 Tipping Load** — Tipping load is the load producing a tipping condition at a specified radius. Mass of hook, hook block, slings shackles, etc, except that of the hoist rope itself shall be considered part of the load.

**7.3 Backward Stability (Counter Mass Limitations)** — To maintain a reasonable margin of backward stability with the subject equipments, counter mass shall be limited by the mass distribution specified below, established when the machine is on a firm level supporting surface; equipped with the shortest recommended radius, with hook, hook block, bucket or other load handling equipment resting on the ground; and with outriggers, if provided, retracted and free off the ground.

a) *Crawler Cranes* — The horizontal distance between the centre of gravity of the crane and the axis of rotation shall not exceed

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\*Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists.

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70 percent of the radial distance from the axis of rotation to the backward tipping fulcrum in the least stable direction.

### b) *Truck and Wheel Mounted Cranes*

- 1) With the longitudinal axis of the rotating superstructure of the crane at 90° to the longitudinal axis of the carrier, the total load on all wheels on the side of the carrier under the jib shall not be less than 15 percent of the total mass of the crane.
- 2) With the longitudinal axis of the rotating superstructure of the crane in line with the longitudinal axis of the carrier, in either direction, the total load on all wheels under the lighter loaded end of the carrier shall be not less than 15 percent of the total mass of the crane.

**7.4 Rated Loads** — Lifting crane rated loads at specified radii shall not exceed the following percentages of tipping load at specified radius:

	<i>Percent</i>
Crawler mounted machines	75
Rubber tyre mounted machines	85
Machines on outrigger	85

## 8. JIB

**8.1** Jib and its attachments shall be designed to withstand the sum of the stresses arising under working conditions including:

- a) All stresses due to load,
- b) All stresses due to mass of the jib and its attachments,
- c) Accelerating and retarding forces acting horizontally at the jib head pin due to slewing of the load,
- d) Accelerating and retarding forces acting horizontally due to slewing of the jib,
- e) Stresses due to wind pressure of 250 Pa,
- f) Accelerating and retarding forces acting vertically and horizontally due to derricking of jib,
- g) Transverse shear stress due to 2½ percent of maximum axial load, and
- h) Stress due to sudden application of slew and luff brakes.

## 9. SPEEDS

**9.1** The various operational speeds shall be as agreed to between the manufacturer and the purchaser. However, the recommended

maximum speeds for a crane handling its working load on a firm level surface, are given in Appendix D.

## 10. WIRE ROPES

**10.1** Unless otherwise specified or agreed to by the purchaser, ropes shall comply with the relevant Indian Standards ( *See Appendix C* ).

**10.1.1** The breaking strength of all splicings, sockets, thimbles and rope anchorages shall be not less than 90 percent of the minimum breaking strength of the rope or ropes to which they are attached.

**10.2** The factor of safety based on nominal breaking strength and rated lifted load shall be as follows:

- a) *Service Condition* — The factor of safety for running ropes and standing ropes which pass over pulleys shall be not less than 4.0. For straight standing ropes the ratio should be not less than 3.0.
- b) *Erection Condition* — The ratio for running ropes and standing ropes which pass over pulleys shall be not less than 3.0. For straight standing ropes, the ratio should be not less than 2.5.

**10.3** When the load is supported by more than one part of rope, the tension in each part shall be considered to be equal.

**10.4** The derricking rope shall be of sufficient length to permit the jib being raised or lowered to the horizontal position during erection or inspection of the crane, without the assistance of the hoisting rope.

**10.5** Reverse bends shall be avoided as far as possible.

## 11. ROPE DRUMS

**11.1 Material for Drums** — Drums shall be made of cast iron, cast steel or mild steel conforming to relevant Indian Standards. The minimum requirement is as follows:

- |                   |                 |                                   |
|-------------------|-----------------|-----------------------------------|
| a) Grey cast iron | Grade FG 260 of | IS : 210-1978*                    |
| b) Cast steel     | Grade 23-45 of  | IS : 1030-1974†                   |
| c) Mild steel     |                 | IS : 226-1975‡<br>IS : 2062-1980§ |

**11.2 Strength of Drums**—Every drum shall be designed to withstand the stress caused by the wound-on rope and the local bending stress when the rope is winding on.

\*Specification for grey iron castings ( *third revision* ).

†Specification for carbon steel castings for general engineering purposes (*second revision*).

‡Specification for structural steel (standard quality) ( *fifth revision* ).

§Specification for structural steel (fusion welding quality) (*second revision*).

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**11.2.1** The bending stress due to beam action of the drum shall also be taken into consideration.

**11.3 Diameter of Drums and Pulleys** — The diameter of drums and pulleys measured at the bottom of the groove shall in no case be less than:

a) 14  $d$  for drums, and

b) 17  $d$  for pulleys,

where  $d$  shows the diameter of the rope.

**11.4 Grooving of Drums** — Grooving shall be smooth and free from surface defects liable to injure the rope. The edges shall be rounded. The contour at the bottom of the groove shall be circular over an angle of approximate 120°. The radius of the groove shall be larger than the radius of the rope by not less than the appropriate amount given in Table 1.

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**TABLE 1 RADIUS OF GROOVE IN DRUMS AND SHEAVES**

( *Clauses 11.4 and 12.1* )

DIAMETER OF ROPE	INCREASE OVER ROPE RADIUS
mm	mm
Up to and including 16	1.0
Over 16 and including 24	1.5
Over 24 and including 28	2.0
Over 28	3.0

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**11.4.1** The depth of the groove shall be not less than 0.35 times the diameter of the rope.

**11.4.2** The grooves of the drum shall be so pitched that there is between adjacent turns of the rope a clearance of not less than:

a) 1.5 mm for ropes up to and including 12 mm dia,

b) 2.5 mm for ropes over 14 mm and including 28 mm dia, and

c) 3.0 mm for ropes over 28 mm dia.

**11.5 Length of Drum** — Drums may be designed to accommodate rope in a number of layers. There shall be not fewer than two dead turns at the anchored end.

**11.6 Flange** — Unless adequate arrangements are made to prevent the rope from running off the drum, the drum shall be flanged at both ends. When the rope is fully drum wound on the drum, the flanges shall project a distance of not less than 1½ rope diameters beyond the rope. A spur, or other wheel or a ring secured to the drum may be regarded as forming the flange.

**11.7 Rope Anchorage** — The end of the rope shall be anchored to the drum in such a way that the anchorage is readily accessible.

**11.8** The lead angle of the rope shall not exceed  $5^\circ$  (1 in 12).

## **12. SHEAVES**

**12.1 Grooving** — Sheaves shall be machine grooved to a depth of not less than 1.5 times diameter of rope. The grooves shall be finished smooth and shall be free from surface defects likely to injure the rope. The contour at the bottom of the groove shall be circular over an angle of  $130^\circ$  approximately. The radius of the part of the groove shall be larger than the radius of rope by not less than the appropriate amount in Table 1.

**12.2 Lead Angle** — The angle between the rope and a plane perpendicular to the axis of the sheave shall not exceed  $5^\circ$  (1 in 12).

**12.3 Sheave Guards** — Sheaves shall be adequately guarded to retain the rope in the grooves.

**12.4** All sheaves, guide pulleys or rollers shall preferably be mounted on ball or roller bearings.

**12.5** Suitably designed supports shall be fitted on the jib and other parts of the structure where required, for the purpose of preventing chafing or damage of the ropes.

## **13. SHAFTS**

**13.1 General** — Shafts and axles shall have ample strength and rigidity and adequate bearing surfaces for their purposes. They shall, where necessary, be finished smoothly and, if shouldered, shall be provided with fillets of as large a radius as possible and/or be tapered to suit.

**13.2 Material** — All shafts shall be made of steel of suitable quality.

**13.3. Shaft Keys** — Where practicable, keys, keyways and splines shall conform to the relevant Indian standards. ( *See* Appendic C. )

## **14. BEARINGS**

**14.1 Type** — Bearings shall be generally of ball, roller or ring-lubricated type. Bush bearings may be used for shafts running at 450 rev/min or below.

**14.2** Due allowance shall be made for impact and thrust loads. Life of ball and roller bearings shall be calculated in accordance with the manufacturer's recommendations.

**14.2.1** If plain bush bearings are used the bearings pressure may generally not exceed 6.9 MPa on the projected area.

## **15. GEARING**

**15.1 General** — All gears shall have machine cut teeth except for slew racks and their engaging pinions where provided may have cast or machine moulded teeth.

**15.2 Material** — All gears shall be of steel (cast or wrought) except as provided below:

- a) Wheels may have steel rims secured to cast iron centres.
- b) Worm wheels or worm wheel rims shall be of bronze and worm of steel for power operated cranes.

**15.3 Design** — Gears shall be designed in accordance with IS : 4460-1967\*.

**15.4 Fixing** — Keys in gear trains shall be so fitted and secured that they do not work loose in service.

**15.5 Gear Boxes** — Gear boxes shall be so designed that the gears which they enclose will be automatically lubricated, the gear shall be readily removable and the boxes shall be oil tight as far as is reasonably practicable. They shall be of rigid construction and fitted with inspection covers and lifting lugs where necessary. Facilities for oil filling, adequate breathing, drainage and means of indicating clearly the correct oil levels shall be provided.

**15.5.1** Where work gearing is used as a first motion drive it shall have under test, the same load and time rating as the driving motor, and the temperature-rise of the oil bath when measured by thermometer shall not exceed 40°C above the temperature of the atmosphere.

**15.5.2** Gear box feet shall be machined and shall be seated and positively located on an appropriate level surface, preferably machined.

**15.5.3** Material for the gear box may be cast iron, cast steel or mild steel fabricated. The material shall conform to the relevant Indian Standard specifications given in **11.1**.

## **16. TYRES, ROAD WHEELS AND CRAWLERS**

**16.1** The crane shall have legible and prominent inscription on the chassis giving the correct inflation pressure of the tyres.

**16.2** Road wheels shall be fitted with resilient tyres of a type to suit application. When pneumatic tyres are fitted the valves shall be brought to the outside of the wheels.

**16.3** Crawler tracks shall be designed to permit operation of the crane without exceeding the ground pressure specified.

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\*Method for rating of machine cut spur and helical gears (Reaffirmed in 1977).



## 17. BOLTS, NUTS, SCREWS AND WASHERS

**17.1** All bolts and set screws in rotating parts shall be locked. Bolts in tension shall be avoided wherever possible.

**17.2** Washers and tapered pads, provided on the under-side of steel sections with tapered flanges shall be tack welded in place.

**17.3** All bolts and nuts shall preferably be in accordance with IS : 1364-1967\* and IS : 1367-1967†. Black bolts and nuts shall not be used generally. The diameter shall be not less than 10 mm in a load carrying member.

**17.4** Washers shall conform to IS : 2016-1967‡, IS : 5372-1969§ and IS : 5374-1969|| as appropriate.

## 18. BRAKES

**18.1.1** *Capacity of Brakes* — Hoisting brake when applied shall arrest the motion and sustain any load up to and including the test load at any position of the lift.

**18.1.1.1** Provision shall be made to control with safety the lowering of any load up to and including the test load.

**18.1.1.2** Brakes in other motions shall be capable of bringing the relevant motions of the fully loaded crane safely to rest.

**18.1.2** *Springs* — Springs for electromechanical brakes shall be of the compression type and shall not be stressed in excess of 80 percent of the torsional elastic limit of the material.

**18.1.3** *Weights* — Brake weights, if provided, shall be securely bolted to their lavers, and locked.

**18.1.4** *Brake Drums and Shoes* — The wearing surface of all brake drums shall be machined, and shall be cylindrical, smooth and free from defects. Brake drums shall, preferably, be balanced.

**18.1.5** *Adjustment* — Brakes shall be provided with a simple and accessible means of adjustment to compensate for wear and removal for relining.

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\*Specification for precision and semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm) ( *first revision* ).

†Specification for technical supply conditions for threaded fasteners ( *first revision* ).

‡Specification for plain washers ( *first revision* ).

§Specification for taper washers for channels (ISMC) ( *first revision* ).

||Specification for taper washers for I-Beams (ISMB) ( *first revision* ).

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**18.1.6 Brake Effort**— Under service conditions brakes applied by hand shall not require a force greater than 100 N at the handle. Brakes applied by foot shall not require a force of more than 145 N at the pedal.

**18.1.6.1** It is recommended that the stroke of hand levers shall not exceed 300 mm and of pedals 150 mm.

**18.1.7 Locking**— Locking devices shall be provided on brake levers where necessary. Brake pedals shall have a non-slip surface.

**18.1.8** Temperature of the rubbing surface of all brakes shall not exceed 100°C for fabric lining and 200°C for asbestos or metals lining.

**18.2 Hoisting and Derricking Motion Brakes**— Hoisting and derricking motion brakes shall be designed to exert a restraining torque at least 25 percent greater than the torque transmitted to the brake drum from the suspended load. In estimating this torque the effects of friction in the transmission details between the load and the brake shall be ignored.

**18.2.1** While the above mentioned restraining torque is being exerted, the stresses in any part of the brake construction, excluding springs, shall not exceed those based on a factor of safety of 6.

**18.2.2** The temperature of the rubbing surfaces of the brake shall not exceed the allowable figure as indicated in **18.1.8**, after the maximum safe working load has been raised and then lowered on the brake five times without pause through the specified height of lift ( see Appendix B ). It is recommended that the hoisting and derricking motion brakes should be automatic so that the brakes are applied when the control handle is moved to the 'Off' or 'Neutral' position.

**18.3 Slewing Brake**— Suitable arrangements shall be made for arresting the slewing motion and preventing the superstructure from slewing under normal service conditions.

**18.3.1** Provision shall be made to secure the superstructure from slewing in its normal position for travelling.

**18.4 Travelling Brakes**— Effective travelling brakes shall be fitted when the crane is designed to travel on the highway, brakes shall comply with appropriate regulation and the purchaser shall inform the manufacturer of any requirements in this respect.

**18.4.1** Hand parking brakes should be capable of holding the crane stationary on a gradient of 1 in 8 when applied with a hand pressure of 294 N.

## 19. LIFTING HOOKS

**19.1 General** — Lifting hooks shall comply with the relevant Indian standard specification whenever available.

**19.2 Mountings** — Swivelling hooks shall be mounted on thrust bearings and a protective skirt shall be provided to enclose the bearings. If required a locking device shall be fitted to prevent rotation of hook.

**19.3** The hooks shall be:

- a) provided either with an efficient device to prevent the displacement of the sling from the hook.

*or*

- b) of such shape as to reduce as far as possible the risk of such displacement.

**19.4** The safe working load shall be legibly stamped on a non-vital part on each hook and/or the bottom block and a test certificate shall be supplied if required.

## 20. SHACKLES

**20.1** Shackles shall comply with the relevant Indian Standard and shall be provided with screwed pins which shall be suitably locked.

**20.2** Each shackle shall be legibly stamped on a non-vital part with an identification number and the pin of the shackle shall bear the same number.

**20.3** When the load on the shackle is not perpendicular to the axis, the allowable load shall be reduced depending on the angle at which it is applied.

## 21. OVERHAULING MASS

**21.1** Where an overhauling mass is used on the rope it shall have a smooth-bore and be bell-mounted at the top and bottom unless the rope is efficiently served, or otherwise protected, and provision shall be made for the examination of the part of the rope passing through the mass.

## 22. PAWLS

**22.1** Where pawls and ratchet wheels are used they shall be of steel of suitable quality for the duty.

## 23. DRIVER'S CAB

**23.1** The cab shall afford the driver adequate protection from the weather and shall have an emergency exit. The windows shall be fitted with safety glass.

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**23.2** The cab together with control levers and pedals shall allow the driver, when in his normal driving position, ample room for operation. It shall afford as far as possible an unrestricted view of load and adequate all round visibility.

**23.3** A seat shall be provided for the driver and shall be so placed that all control handles and pedals are within his easy reach.

### **24. OPERATION OF CONTROL LEVERS**

**24.1** The total maximum travel of control levers shall be not greater than 600 mm for a lever working in one direction and 300 mm on either side of the neutral position for 2-way lever.

**24.1.1** The travel of foot pedals shall be not more than 250 mm.

**24.2** For any manual operation of control levers under normal working conditions, the operator shall not be required to exert a force greater than 122 N at the handle. If operated by foot, they shall not require a force greater than 294 N. For turning a handle, the force required shall not exceed 122 N.

### **25. GUARDING**

**25.1 General** — Effective guards shall be provided for gear wheels, chain drives and revolving shafts, couplings, collars and set screws or similar moving parts, unless those parts are made safe by design or by position or are effectively guarded by parts of the crane structure.

**25.2 Design** — The guard may be of sheet metal, perforated or expanded metal, wire mesh, wood, pressed fibre or other material as may be deemed most suitable, and should completely encase the parts concerned. The guards should be designed to allow for routine inspection and maintenance work.

**25.2.1** The guards should be substantially constructed of material suitable to withstand the atmospheric conditions in the situation in which the guards are to be used and shall be sufficiently rigid to resist distortion.

**25.2.2** The guard shall be securely attached to a fixed support.

**25.3 Thickness** — The thickness of metal guards shall be not less than 1 mm and of wooden guards not less than 18 mm.

NOTE — An increased thickness or the use of corrosion resisting material, is desirable in damp and corrosive atmospheres.

**25.4 Size of Opening and Clearance** — The minimum clearance between the guard and the moving parts and the size of opening in

guards of perforated metal, woven wire, metal lattice or similar material shall be in accordance with the requirements in Table 2.

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**TABLE 2 SIZE OF OPENING AND CLEARANCE**

SIZE OF OPENING, mm	MINIMUM CLEARANCE, mm
Not exceeding 10	25
Over 10 up to and including 15	50
Over 15 up to and including 30	100
Over 30 up to and including 40	125

NOTE — Size of opening means the greatest dimensions of the opening except in the case of slotted material when the length of the slot may be disregarded if the width of the slot does not exceed 15 mm.

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## **26. WEATHER PROTECTION**

**26.1** All electrical and mechanical equipment outside cabin and machinery house shall be adequately protected from weather. All weather proof covers shall be easily removable.

## **27. LUBRICATION**

**27.1** Provision shall be made for lubricating all bearings which shall be easily accessible from the working platforms of the cranes.

**27.2** In case centralized lubrication is provided it shall be mentioned in Appendix A. In this case provision shall be made at the bearings to vent excess lubricant pressure.

**27.3** Lubricating nipples, pipes, and adapters shall generally comply with the relevant Indian standards ( *see* Appendix C ).

**27.4** A lubricating chart in the maintenance manual shall be provided indicating all the lubricating points, the type of lubricant and recommended frequency of lubrication.

**27.5** Grease lubricated ball and roller bearings shall in addition be packed with grease during initial assembly.

## **28. PAINTING**

**28.1** Before despatch of the crane the complete crane covering structural, mechanical and electrical parts shall be thoroughly cleaned of all dirt, grease, scale and rust and then given a single coat of primer. Mechanical and electrical components shall be given an additional

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finish coat of paint of colour of customer's choice. The exposed mechanical parts of the crane shall be given one coat of rust preventor.

### **29. PROTECTIVE DEVICES**

**29.1** Devices which are able to be operated either by power or by hand should be of such design that power may not actuate the manual drive inadvertently.

**29.1.1** Except when the mechanism driving the derricking drum is self locking, or when the derricking drum is independently driven, an effective interlocking arrangement shall be provided between the derricking clutch and the brake or pawl sustaining the derricking drum. The arrangement shall ensure that the sustaining brake cannot be released until the clutch is effectively engaged, and that the clutch cannot be disengaged until the brake is effectively engaged, whether the drum is under load or not.

**29.1.1.1** If a sustaining pawl is used, its installation and position should be such that when it engages, to prevent the jib from falling, the free movement of the jib shall not exceed an amount equivalent to the pitch of the ratchet wheel.

**29.2 Automatic Safe Load Indicator** — A device fitted to a crane, or incorporated in its design, that automatically gives visual indication to the driver when the load being lifted or carried by the crane approaches the safe working load, and that also gives a continuous audible warning to the driver and other persons in the vicinity when the load being lifted or carried exceeds the safe working load ( *see* definition of 'safe working load' ). Under certain statutory regulations the automatic safe load indicator should be of a type approved by Chief Inspector of Factories.

**29.3 Audible Warning Device** — There shall be a clearly audible warning device which can be operated from the driver's cabin.

### **30. INTERNAL COMBUSTION ENGINES**

**30.1** Internal combustion engines shall comply with relevant Indian Standards on the one hour basis, and a silencer shall be fitted to the exhaust. The exhaust pipe shall be fitted in such a position that the exhaust fumes of the engine do not reach the driver. Fuel tank capacity shall be sufficient for at least 8 hours running on normal crane duty, and means shall be provided for ascertaining the amount of fuel contained in the tank.

**30.2** When required by the purchaser, a spark-arrestor shall be fitted to the silencer.

**30.3** The sump and lubrication system of the engine shall be so arranged that efficient lubrication is maintained to all bearings when the engine is operating in any plane inclined at angle of 1 in 4 to the horizontal.

**30.4** Provisions shall be made for draining the water circulating system during frosty weather, the drain cocks being fitted in accessible position. The arrangement shall be such that it is not possible to leave pockets of water either in the system or in the pump casing.

### SECTION III ELECTRICALS

#### 31. GENERATORS AND MOTORS

**31.1 Ratings and Enclosures** — The ratings shall be such that, under the specified service conditions, the temperature rise will not exceed the limits specified in IS : 325-1978\* for three phase induction motors or other relevant Indian standards. This shall not preclude use of intermittent rated motors if required. Where dc motors are used, the provisions regarding rating and enclosure shall be as agreed to between the manufacturer and purchaser.

**31.1.1** The enclosures shall suit the specified service conditions and shall be stipulated with the enquiry or order.

**31.2** Motors shall be suitable for frequent acceleration, braking and where applicable for reversing.

**31.2.1** If it is intended to retard or stop the motion of a crane by electric braking, the motor shall be of suitable design to withstand this duty.

**31.3 Mountings** — Generators and motors shall be so located that the brush-gear and terminals are accessible for inspection and maintenance and normal ventilation is not restricted.

**31.4 Terminals** — Generator and motor leads shall be brought out from the frame to terminals in the terminal box fixed to the frame.

#### 32. CONTROLLERS

**32.1 General** — Controllers shall be adequately protected to prevent accidental contact with live parts.

**32.2 Ratings** — Controllers shall be adequately rated for the duties specified.

**32.3 Accessibility** — All controllers shall be so disposed that the contacts and terminal arrangements are readily accessible for inspection and maintenance.

**32.4 Marking and Direction of Operation of Controllers** — Where practicable, controller handles should move in the direction of the resultant load movement. Each controller shall be marked in a permanent manner to show the motion controlled and, wherever practicable, the direction of movement.

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\*Specification for three phase induction motors ( *fourth revision* ).

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**32.5 Notching** — The notching for the controller handle in the 'OFF' position shall be more positive than the notching in other positions. The handle may be provided with a lock, latch, dead man or spring return feature if specially requested by the customer.

**32.5.1** Control levers shall be provided with stops and/or catches to ensure safety and facility of operation. If the controller drum is fitted, a star wheel will be regarded as complying with the requirements.

## **33. RESISTORS**

**33.1 General** — Resistors shall be adequately protected to prevent accidental contact with live parts.

**33.2 Rating** — Resistors shall be rated such that the temperature does not exceed the limits specified in the relevant Indian Standards during the operation of the crane under service conditions. The ohmic value and current carrying capacity of the resistors shall be computed and specified according to the actual torque requirements of the motion served and not on the motor size which may be sent by thermal requirements.

**33.2.1** Resistors shall be rated according to the service conditions and the mechanical class of the crane and shall preferably be intermittent rated. Short time rated resistors may, however, be used.

**33.3 Fittings** — Resistors shall be enclosed in well-ventilated housing and wherever necessary be fitted with suitable covers. Resistor assemblies shall be so mounted as to ensure an adequate flow of cooling air.

## **34. ELECTRICAL CONTROL AND PROTECTIVE GEAR**

**34.1** If electrically operated contactor panel is used for the control of all crane motions, the protective devices in the panel shall be such that each crane motion has separate protection.

**34.2** All motors and generators shall be suitably protected against over loading.

**34.3** If supply is from an external source, the isolated switch shall be fitted in an easily accessible position. If supply is self-generated, and of the standard voltage type, the isolation switch shall be fitted in an easily accessible position so as to isolate the supply from the control panel.

**34.4** It shall not be possible to reinstate the current supply of the contractor closing coils of a motion until the controller for the motion is returned to the 'OFF' position.

**34.5** To prevent quick reversal of movement by the operator from hoisting to lowering, an interlock in the middle point may be provided.

## **35. BRAKE MAGNET**

**35.1** Brake magnet coils shall conform to the ratios shown in Table 3.



**TABLE 3 BRAKE MAGNET RATINGS**

( Clause 35.1 )

DUTY	dc MAGNETS	ac MAGNETS
Heavy duty	Suitable for being in circuit not more than 7½ minutes out of every 15 minutes	Suitable for being in circuit continually where the brake coil operates infrequently
	<i>or</i>	<i>or</i>
	240 operations per hour	for 240 operations per hour where the time that the brake coil is in circuit is not more than 5 minutes out of every 15 minutes
Normal duty	Suitable for 240 operations per hour where the time that the brake coil is in circuit is not more than 5 minutes out of every 15 minutes	Suitable for 240 operations per hour where the time that the brake coil is in circuit is not more than 5 minutes out of every 15 minutes

## 36. WIRING DIAGRAM

**36.1** A wiring diagram or a circuit diagram or both shall be supplied. The diagram shall give the rating of each of the motors, the cable sizes and such other information as will tend to facilitate inspection and maintenance of the crane.

## 37. LIGHTING

**37.1** Travelling lights shall comply with *Road Vehicle Lighting Regulations*, where applicable.

## 38. CABLE WIRING FOR POWER CIRCUIT

**38.1 Cables** — Rubber, insulated cables and polyvinyl chloride insulated cables used for crane wiring should comply with the relevant Indian standards ( *see* Appendix C ).

**38.2 Minimum Size** — The minimum cross-sectional area of cables shall be as follows:

For power circuits 2.5 mm<sup>2</sup> copper,

*or*

6 mm<sup>2</sup> aluminium

For control circuits 1.5 mm<sup>2</sup> copper

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**38.3 Protection** — All cables shall be adequately protected against mechanical damage and metal trunking may be used if desired. Cable conduits shall comply with relevant Indian Standards ( *see* Appendix C ). If cables are drawn into a steel tube, the steel tube shall be of heavy gauge welded or solid drawn screw joined.

**38.4 Identification** — Proper identification of cables as per wiring diagram shall be provided.

**38.5 Multicore Cables** — Multicore power and control cables suitably clamped to the crane structure may be used. Suitable clamping glands should be provided at both ends of each multicore cable.

**38.6 Current Rating** — Ratings of the cables shall comply with the relevant Indian standard specifications ( *see* Appendix C ). Where cranes are equipped with one-hour rated motors, the stator or armature cables may be uprated by a factor of 1.4 above the ratings for continuous duty. Similarly, for cranes equipped with half-hour rated motors, an uprating factor of 1.7 may be used. Where the cranes are equipped with intermittent duty rated motors, the factor for uprating

the cable will be equal to  $\sqrt{\frac{100}{IDF}}$  where IDF is the intermittent duty factor of the motor.

**38.6.1** The cables for rotor or armature resistor circuits carry current during accelerating periods only and may, therefore, be further uprated. For 5 minutes rated resistors, the uprating factor of 2 may be used. For intermittent rated resistors, suitable uprating factors may also be applied.

**38.6.2** Consideration should be given to such factors as the ambient temperature, grouping and disposition of the cables, and to the limitation of voltage drop, which will influence selection of suitable cables.

## SECTION IV HYDRAULIC

### 39. HYDRAULIC EQUIPMENT

**39.0 General Requirements** — Back pressures which may affect the safety of the crane shall be prevented or effectively relieved.

Provision shall be made in the installation for effective filtration of the working fluid and for protection of the fluid against pollution.

The raising of the pressure at any point to a value above the safe maximum, due to any effect whatsoever, shall be prevented by positive means.

A hydraulic circuit diagram shall be provided.

### **39.1 Power Transmission**

**39.1.1 Safety Devices** — The system shall be so designed as to be fail safe.

**39.1.2 Installation** — The installation of the hydraulic system shall be such that as far as possible the effects of external influences (such as atmospheric condition, unauthorised interference and mechanical impact) shall not be detrimental to the system. In addition, installation stresses in the tubes shall be avoided and flexibility of the supporting members shall be allowed for on all rigid tubes.

**39.1.3 Speed of Flow** — As far as practicable cavitation and back pressure shall be avoided by the use of suitable speeds of fluid in tubing and components.

**39.1.3.1** Tubes and hoses shall be dimensioned with due consideration for the pressure and rate of flow of fluid in them. They should not be bent to radii smaller than recommended by the manufacturer.

**39.1.3.2** Connectors and unions shall be dimensioned with due consideration for the pressure and rate of flow of fluid in them, and the resistance they are likely to cause.

**39.1.4 Temperature of Fluid** — If required, under normal circumstances to keep the temperature of the fluid within the limits specified by the fluid supplier, a cooler shall be fitted.

**39.1.5 Fluid Reserve** — Tanks shall have a sufficient capacity to guarantee an uninterrupted flow of fluid to all rotating machinery whilst working, and hold a sufficient reserve of fluid to keep the temperature within the limits specified by the supplier in those cases where no other cooling device is fitted.

**39.2 Controls** — The circuit and control arrangement shall be such that no combination of control selections in one circuit can cause in any other circuit a movement not intended by the operator, unless this is essential for the operation of a safety device or interlock.

**39.2.1** Provision shall be made to prevent the load from driving hydraulic motors beyond acceptable limits. Hydraulically powered motions shall not allow un-intentional movement except for creep caused by normal internal leakage.

**39.2.2** Hydraulic shock caused by the sudden closure of a control valve coupled with the over-running action of a particular motion of the crane shall be effectively relieved.

**39.2.3** Valve lever handles shall have upon them, or adjacent to them, clear markings to indicate their purpose and mode of operation.

## **SECTION V PNEUMATIC EQUIPMENT**

### **40. POWER TRANSMISSION**

**40.1** The pneumatic system shall be of sufficient dimensions and be provided with adequate equipment to ensure its proper functioning, for example:

- a) Compressor;
- b) Automatic pressure regulator;
- c) Air filter (if required, one to be arranged before and one after the compressor);
- d) Antifreezer (for introducing antifreeze mixture into the piping); if necessary, for the working condition; and
- e) Air reservoir.

**40.2** Tubes and hoses shall be dimensioned with due consideration of the pressure and quantity of the air circulating in the system. They either shall be made of copper or their inner side must be protected against corrosion. It is recommended that for the assembly of piping the instruction which the manufacturer has issued in respect of unions and bending radii should be applied. Where great flexibility of piping is required, rotary unions should be given. The piping shall be of sufficient cross section and such layout as to reduce pressure loss due to flow in the pipe to an acceptable value and to permit the operation of the power motion without undue time lag.

### **41. INSTALLATION**

**41.1** The installation of conduits and other units of the system should be carried out in such a way that a uniform inclination is obtained, if possible towards water drain valve. Stress shall be carefully avoided when assembling and the system must not be adversely affected by any movement of the super-structure or under carriage. When required a suitable protection from a mechanical damage shall be provided.

**41.2** Controls and the relevant accessories shall be so assembled and installed that their operational safety is retained under operating conditions.

### **42. TEMPERATURE**

**42.1** The temperature in the pneumatic system shall not exceed the permissible limit.

### **43. AIR RESERVOIR**

**43.1** Air reservoir together with their fittings shall be in accordance with an accepted standard. They shall be of sufficient capacity so that

minimum working pressure is always ensured under normal working condition. It is recommended that the sufficient air pressure is available for the operation of fundamental function, to the safety of the machine before air may be used for the servo assistance etc, for machines. The air reservoir shall be at convenient position and its cooling should be assured.

## SECTION VI TESTING

### 44. TEST REQUIREMENTS

#### 44.1 General

**44.1.1** The aim of testing is to demonstrate that the crane conforms to the requirements stipulated by the specification and to verify the behaviour of component parts. When conducting acceptance tests, the manufacturer shall be entitled to employ his own crane driver.

**44.1.2** The tests shall be the responsibility of the manufacturer and shall be carried out at the manufacturer's works or at a place agreed to between the purchaser and the manufacturer. Additional tests may be carried out subject to agreement between the manufacturer and the purchaser.

**44.1.3** All tests shall be carried out on a firm and level surface ( $\pm 0.5$  percent slope) during weather conditions in which the wind speed does not exceed 8.3 m/s. Tyres where fitted, shall be inflated to pressures specified by the manufacturer for normal crane duties.

**44.1.4** Cranes provided with outrigger jacks shall be tested without outrigger where permitted, and with outriggers fully extended unless otherwise specified by the manufacturer as specified in **44.1.3**.

**44.1.5** The manufacturer shall clearly indicate whether or not the hook block is to be considered as part of the test load.

The mass of slings, equalizing beams and other similar devices for handling test loads shall be taken as part of the test load.

**44.1.6** In the case of first production machines, all tests defined in **44.2** shall be carried out for all lengths of jibs and also, where applicable for all lengths and configurations of jib with fly jib, mast/tower with jib and mast/tower with jib and fly jib.

**44.1.7** In the case of subsequent production machines, all tests defined in **44.2** shall be carried out for all applicable lengths and configurations of jib, jib with fly jib, mast/tower with jib and mast/tower with jib and fly jib as specified in Tables 4, 5 and 6 commensurate with the equipment ordered by the purchaser.

**TABLE 4 TEST CONFIGURATIONS FOR TELESCOPIC JIB  
ARRANGEMENTS**

( Clause 44.1.7 )

ARRANGEMENT	LENGTH OF MECHANIZED TELESCOPIC SECTIONS	LENGTH OF EXTENDED MANUAL TELESCOPIC SECTIONS	LENGTH OF FLY JIB	
(1)	(2)	(3)	(4)	
Mechanized telescopic jib	Shortest Intermediate Longest	— —	—	
Mechanized telescope jib with fly jib	Longest, appropriate to maximum fly jib rating	—	At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest
			At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest
	Longest	—	At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest
			At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest
Mechanized telescopic jib with manual telescopic sections	Longest	Shortest	—	
		Longest	—	
Mechanized telescopic jib with manual telescopic sections and fly jib	Longest	Shortest	At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest
			At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest
		Longest	At minimum offset	Shortest Longest
			At maximum offset	Shortest Longest

NOTE — If fly jib ratings at minimum offset are similar to those at maximum offset, then tests at minimum offset are not applicable.

**TABLE 5 TEST CONFIGURATIONS FOR STRUT JIB ARRANGEMENT**  
( Clause 44.1.7 )

ARRANGEMENT	JIB LENGTH	FLY JIB LENGTH	
(1)	(2)	(3)	
Jib	Shortest	—	
	Intermediate	—	
	Longest	—	

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Jib with fly jib	Longest appropriate to maximum fly jib rating	At minimum offset	Shortest
			Longest
	Longest	At minimum offset	Shortest
			Longest
		At maximum offset	Shortest
			Longest

NOTE — If fly jib ratings at minimum offset are similar to those at maximum offset, the test at minimum offset is not applicable.

**TABLE 6 TEST CONFIGURATIONS FOR MAST/TOWER AND JIB ARRANGEMENTS**

( Clause 44.1.7 )

ARRANGEMENT	LENGTH OF MAST/TOWER	LENGTHS OF JIB (TELESCOPIC OR STRUT) AND FLY JIB
(1)	(2)	(3)
Mast/tower with jib	Shortest	As in Table 4 or 5
	Longest	As in Table 4 or 5
Mast/tower with jib and fly jib	Shortest	As in Table 4 or 5
	Longest	As in Table 4 or 5

## **44.2 Tests**

**44.2.1 Functional Tests** — The operational functions of the complete crane shall be tested with no load to demonstrate the following:

- a) The satisfactory operation of each control device, and where fitted, each cut-out device for overhoisting, overlowering, overslewing and overderricking.
- b) The satisfactory operation of each crane motion at the specified unladen operating speeds or times.

### **44.2.2 Overload Test**

- a) An overload test shall be performed at the maximum specified radius or minimum specified jib angle and at the appropriate radius or jib angle for the maximum safe working load for the particular configuration under test.
- b) Each test shall consist of applying an overload of 10 percent of safe working load at the appropriate radius or jib angle as specified in **44.2.2 (a)**. The test load shall be lifted and lowered by operating the barrel through one full turn after the load has just cleared the ground. The load need not be stopped during the raising operation. The load shall be maintained just clear of the ground for the remainder of the test except when it is necessary to clear such obstructions as outriggers.
- c) During each test, all permissible crane motions shall be operated separately consistent with safe handling and control of the test load.

The load shall be slewed through the specified angle of rotation or through the maximum angle which is physically possible because of the shape of the test load.

The load shall be derricked inwards by one radius decrement or jib angle increment and returned to its original position. During the test the derricking barrel must turn one full revolution.

### **44.2.3 Testing of Indicators**

- a) The settings and satisfactory operation of the automatic overload indicator, if fitted, shall be confirmed during the course of the test.
- b) The settings and satisfactory operation of the radius and/or jib angle indicator, if fitted, shall be confirmed during the course of the test.

**44.2.4 Stability Tests** — If desired, the manufacturer shall demonstrate that the stability of the crane complies with the requirements of 7, except



in following cases, at minimum radius (or maximum jib angle) or where structural strength or other limitations limit the capacity, the load applied do not exceed 10 percent of safe working load for the crane in the condition tested. At other radii the load applied shall not exceed the safe working load plus the additional load required to demonstrate the specified margin of stability. To compensate for tyre and other deflections when a load is applied, the radius shall be adjusted to the appropriate rated working radius measured at ground level.

NOTE 1 — It should not be inferred that this test required the crane to be brought to condition of tipping.

NOTE 2 — Tests on gradients greater than 0.5 percent are excluded.

#### **44.2.5 Performance Test with Rated Load(s)**

- a) Tests to establish satisfactory operation of each crane motion shall be performed separately. The crane shall be subjected to all admissible movements, and with all normal precautions taken.

The crane shall be set up as specified by the manufacturer and the tests carried out with rated load(s) applicable, at the maximum radius or lowest jib angle and at the appropriate radius or jib angle for the maximum safe working load for the particular configuration under test at the position of least stability. The foregoing does not exclude a customer requiring two motions to be tested at one time where this is permissible.

- b) During the tests described in 44.2.5 (c) to (g), speeds up to the maximum specified may be attained and verified but, operating speeds, accelerations and decelerations should be those consistent with safe handling and control of the load. To compensate for tyre and other deflections when load is applied the radius shall be adjusted to the appropriate rated working radius measured at ground level.
- c) *Hoisting and Lowering* — The rope shall be reeved in accordance with the manufacturer's specified arrangement for the configuration under test. The load shall be hoisted to maximum height and lowered to near ground level. A similar test shall be carried out on other auxiliary hoisting units where fitted.
- d) *Slewing* — The revolving portion shall be slewed in both directions through 360° or, in the case of a part slewing crane, the maximum angle, through which slewing is permissible.
- e) *Derricking* — The jib shall be derricked in both directions through the full range of radii or jib angles which are permissible to the load suspended.

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- f) *Telescoping* — For cranes fitted with telescopic booms the telescoping motion shall be tested through the range of duties specified by the manufacturer.
- g) *Travelling* — Where travelling with the load is permissible, the travelling motion shall be tested in both directions with the jib in any position within the slewing arc specified by the manufacturer. Precautions may be taken to limit the swinging of the load.

### 44.2.6 *Travelling Tests ( Crane without Load in Travelling Order )*

- a) *Speed* — The maximum speed of the crane (mobile or truck mounted) shall be measured on a dry, straight, level road after the vehicle has gathered speed. This measurement shall be made in both directions and the average speed shall be calculated. If desired, the speeds obtained at the same engine revolutions may be checked for different gearbox ratios. The speed shall comply with that specified by the manufacturer.
- b) *Manoeuvrability* — With the steering wheels at maximum lock, the turning diameter on left lock and right lock of the track traced by the outside and inside wheel shall be measured.
- c) *Braking* — Depending on the classification of the crane, the travelling brakes shall be checked for satisfactory operation.

The tests shall be demonstrated on dry hard level ground and shall be carried out in calm weather without inducing skidding.

**44.3 Certificate** — On the satisfactory completion of the tests, certified records shall be supplied to the purchaser. These records shall contain the following:

- a) Description of crane, serial number and manufacturer's name;
- b) All safe working loads and their appropriate radii or jib angles;
- c) The test loads which were applied and their appropriate radii/jib angles;
- d) Length of jib, fly jib and mast/tower tested; and
- e) Method of crane chassis support, namely, a) free on wheels/crawler tracks; b) on wheels/crawler track assisted by stabilizing jacks; or c) on stabilizing jacks.

**44.4 Verification of Crane Details** — The general details of cranes, as supplied in accordance with Appendix B, shall be verified, if required, by the customer or his inspection agent in conjunction with the manufacturers.

## APPENDIX A

( *Clauses 0.4 and 27.2* )

### INFORMATION TO BE SUPPLIED WITH ENQUIRY OR ORDER

**A-0.** The following information in regard to the details of the crane should be supplied at the time of enquiry/order.

**A-1.** State whether crane is required to be fully mobile, full slewing type, etc ( *see 1.1* ).

**A-2.** Number of cranes .....

**A-3.** Is crane to be used with hook, grab or magnet? If required for grab or magnet, the following additional information should be given:

- a) Nature of material to be handled,
- b) Mass per cubic metre and grain size,
- c) Out put in t/h,
- d) Type of grab and number of ropes, and
- e) If the purchaser is to supply the grab, give the empty and gross grab bucket mass.

**A-4.** Crane capacity in tonnes.....

**A-5.** Range of lift in metres:

- a) Below ground level .....
- b) Above ground level.....

**A-6.** Outreach in metres.....

**A-7.** Site conditions:

- a) Nature of ground over which the crane will have to work, such as hard roads, temporary roads, grass land, etc;
- b) Details of overhead or side restrictions, if any; and
- c) Particulars of the gradient and/or curves the crane may have to negotiate.

**A-8.** Motive power required:

State whether petrol, diesel, diesel-electric or external electric supply.

**A-9.** Type of operators cab required.

**A-10.** Chassis mounting : state whether metal, solid rubber, pneumatic tyres or tracks are required.

**A-11.** Abnormal atmospheric or site conditions, if any.

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**A-12.** Any special requirements, such as lighting, limit switches, and overload indicator.

### **A-13.** Crane performance

Operating speeds:

- a) Hoist.....metre/min.
- b) Slewing.....metre/min.
- c) Derricking.....metre/min.
- d) Travelling.....metre/min.

## **A P P E N D I X B**

( *Clauses 0.4, 18.2.2 and 44.4* )

### **INFORMATION TO BE SUPPLIED BY THE MANUFACTURER**

**B-0.** The following information regarding the crane should be supplied to the purchaser at the time of enquiry or order.

**B-1.** Type of crane offered with drawing or catalogue No .....

**B-2.** Crane capacity:

- a) Load in tonnes at maximum radius in metres .....
- b) Load in tonnes..... at minimum radius in metres.....

**B-3.** Range of lift in metres at approximate radii:

- a) Above ground level.....
- b) Below ground level.....

**B-4.** Crane diagram indicating:

- a) Overall length of chassis;
- b) Overall width of crane;
- c) Overall height of crane with jib in lowest position;
- d) Tail radius of the revolving superstructure;
- e) Distances from centre line of revolving superstructure to ends and sides of chassis and over outriggers, if provided; and
- f) Distances between two kerbs in which the crane may be completely turned round in one movement on:
  - 1) Right look
  - 2) Left look

**B-5. Driving power:**

- a) State whether petrol, diesel, diesel-electric, external electric supply, etc.
- b) If motive power is external electric supply give details of the same.
- c) Particulars of engine, that is, make and rated HP with number of cylinders.

**B-6 Speeds of various motions.**

**B-7. The maximum gradient at which the crane may travel:**

- a) Loaded
- b) Unloaded

**B-8. Description of brakes.**

**B-9. Description of controls of various motions.**

**B-10. Particulars of grab or magnet, if to be supplied with crane.**

**B-11. Particulars of operators cabin.**

**B-12. Type and size of road wheels.**

**B-13. Total mass of the crane without load.**

**B-14. Particulars of safety and indicating devices provided.**

**B-15. List of tools and accessories supplied.**

**B-16. Any other important particulars not scheduled above.**

## **A P P E N D I X   C**

( *Clauses 0.5, 10.1, 38.1 and 38.3* )

### **LIST OF RELEVANT INDIAN STANDARDS AND CODES OF PRACTICE FOR MATERIALS AND EQUIPMENT**

#### **C-1. MATERIALS**

##### **C-1.1 Steel and Casting**

IS : 210-1978 Specification for grey iron castings ( *third revision* )

IS : 226-1975 Specification for structural steel ( *standard quality* )  
( *fifth revision* )

IS : 961-1975 Specification for structural steel (high tensile)  
( *second revision* )

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IS : 1030-1974 Carbon steel castings for general engineering purposes ( *second revision* )

IS : 1387-1967 General requirements for the supply of metallurgical materials ( *first revision* )

IS : 1570-1961 Schedules for wrought steels for general engineering purposes:

(Part 1)-1978 Steel specified by tensile and/or yield properties ( *first revision* )

(Part 2)-1979 Carbon steels (unalloyed steels) ( *first revision* )

(Part 3)-1979 Carbon and carbon-manganese free cutting steels ( *first revision* )

(Part 5)-1972 stainless and heat-resisting steels ( *first revision* )

IS : 1875-1978 Specification for carbon steel, bars, billets, blooms, slabs and bars and for forgings ( *fourth revision* )

IS : 2062-1980 Specification for structural steel (fusion welding quality) ( *second revision* )

### **C-1.2 Threaded fasteners, washers**

IS : 1363-1967 Specification for black hexagon bolts, nuts and lock nuts (diameter 6 to 39 mm) and black hexagon screws (diameter 6 to 24 mm) ( *first revision* )

IS : 1364-1967 Specification for precision and semi-precision hexagon bolts, screws, nuts and block nuts (diameter range 6 to 39 mm)

IS : 1367 Tolerance supply conditions for threaded fasteners:

(Part 1)-1980 Introduction and general information ( *second revision* )

(Part 9)-1979 Surface discontinuities on bolts, screws and studs ( *second revision* )

(Part 10)-1979 Surface discontinuities on nuts ( *second revision* )

(Part 16)-1979 Designation system and symbols ( *first revision* )

(Part 18)-1979 Marking and mode of delivery ( *second revision* )

IS : 2389-1968 Specification for precision hexagon bolts, screws, nuts and lock nuts (diameter range 1.6 to 5 mm) ( *first revision* )

IS : 3640-1967 Specification for hexagon fit bolts

IS : 3757-1972 Specification for high-tensile friction grip bolts ( *first revision* )

IS : 6639-1972 Specification for hexagon bolts for steel structures

### **C-1.3 Wire Ropes**

- IS : 2266-1977 Specification for steel wire ropes for general engineering purposes ( *second revision* )
- IS : 2365-1977 Specification for steel wire suspension ropes for lifts, elevators and hoists ( *first revision* )
- IS : 3973-1967 Code of practice for selection, installation and maintenance of wire ropes
- IS : 6594-1977 Technical supply conditions for steel wire ropes and strands ( *first revision* )

## **C-2. MECHANICAL AND FABRICATION DETAILS**

### **C-2.1 Keys and Keyways**

- IS : 2048-1975 Specification for parallel keys and keyways ( *first revision* )
- IS : 2291-1981 Specification for tangential keys and keyways ( *second revision* )
- IS : 2292-1974 Specification for taper keys and keyways ( *first revision* )
- IS : 2293-1974 Specification for gib-head keys and keyways ( *first revision* )
- IS : 2294-1980 Specification for woodruff keys and keyways ( *first revision* )

### **C-2.2 Welding**

- IS : 816-1969 Code of practice for use of metal arc welding for general construction in mild steel ( *first revision* )
- IS : 818-1968 Code of practice for safety and health requirement in electric and gas welding and cutting operations ( *first revision* )
- IS : 1024-1979 Code of practice for use of welding in bridges and structures subject to dynamic loading ( *first revision* )
- IS : 1323-1982 Code of practice for oxy-acetylene welding for structural work in mild steel ( *second revision* )

### **C-2.3 Gears**

- IS : 2467-1963 Notation for toothed gearing
- IS : 2535-1978 Basic rack and modules of cylindrical gears for general engineering and heavy engineering ( *second revision* )

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IS : 3734-1966 Dimensions for worm gearing

IS : 4460-1967 Method for rating of machine cut spur and helical gears

IS : 5037-1969 Basic rack and modules of straight bevel gears for general engineering and heavy engineering

### **2.4 Rivets**

IS : 1929-1961 Specification for rivets for general purposes (12 to 48 mm diameter)

IS : 2155-1962 Specification for rivets general purposes (below 12 mm diameter)

## **C-3. ELECTRICAL DETAILS**

### **C-3.1 Motors**

IS : 325-1978 Specification for three-phase induction motors ( *fourth revision* )

IS : 900-1965 Code of practice for installation and maintenance of induction motors ( *revised* )

IS : 1231-1974 Specification for dimensions of three-phase foot-mounted induction motors ( *third revision* )

IS : 2223-1971 Specification for dimensions of flange mounted ac induction motors ( *first revision* )

IS : 4722-1968 Specification for rotating electrical machines

### **C-3.2 Cables and Conductors**

IS : 434 (Part 1)-1964 Specification for rubber-insulated cables: Part 1 With copper conductors ( *revised* )

IS : 434 (Part 2)-1964 Specification for rubber-insulated cables: Part 2 With aluminium conductors ( *revised* )

IS : 693-1965 Specification for varnished cambric insulated cables ( *revised* )

IS : 694-1977 Specification for PVC insulated cables for working voltages up to and including 1 100 volts ( *second revision* )

IS : 1554 Specification for PVC insulated (heavy duty) electric cables: Part 1-1976 For working voltages up to and including 1100 V ( *second revision* )

Part 2-1970 For working voltages from 3.3 kV up to and including 11 kV

IS : 1596-1977 Specification for polyethylene insulated cables for working voltages up to and including 1 100 volts ( *second revision* )



IS : 1653-1972 Specification for rigid steel conduits for electrical wiring ( *second revision* )

IS : 2509-1973 Specification for rigid non-metallic conduits for electrical installations ( *first revision* )

### **C-3.4 Switchgear**

IS : 2147-1962 Degrees of protection provided by enclosures for low-voltage switchgear and controlgear

IS : 2516 Alternating current circuit-breakers

IS : 2516 (Parts 1 and 2/Sec 1)-1977 Requirements and tests, Section 1 Voltages not exceeding 1 000 V ac or 1200 V dc ( *first revision* )

IS : 2516 (Part 1/Sec 2)-1980 General and definitions, Section 2 For voltages above 1 000 V ac ( *first revision* )

IS : 2516 (Part 1/Sec 3)-1972 Requirements, Section 3 Voltages above 11 kV

IS : 2516 (Part 2/Sec 2)-1980 Rating, Section 2 For Voltages above 1000 V ac

IS : 3427-1969 Metal-enclosed switchgear and controlgear for voltages above 1 000 V but not exceeding 11 000 V

IS : 4064-1978 Specification for air-break switches, air-break disconnectors, air-break switch disconnectors and fuse-combination units for voltages not exceeding 1 000 V ac or 1 200 V dc:

Part 1-1978 General requirements ( *first revision* )

Part 2-1978 Specific requirements for the direct switching of individual motors ( *first revision* )

IS : 4227-1967 Braided nylon cord for aeronautical purposes

IS : 5124-1969 Code of practice for installation and maintenance of ac induction motor starters (voltage not exceeding 1 000 V )

### **C-4. EARTHING**

IS : 3043-1966 Code of practice for earthing

### **C-5. CRANES**

IS : 807-1976 Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists ( *first revision* )

IS : 3177-1977 Code of practice for electric overhead travelling crane and gantry cranes other than steel works cranes ( *first revision* )

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IS : 4137-1967 Code of practice for heavy duty electric overhead travelling cranes including special service machines for use in steel works

IS : 4594-1968 Code of practice for design of portal and semi-portal wharf cranes ( electrical )

IS : 5532-1969 Glossary of terms for cranes

IS : 6511-1972 Range of preferred safe working loads for cranes, lifting appliances and related excavators equipment

IS : 6521 (Part 1)-1972 Code of practice for design of tower cranes: Part 1 Static and rail mounted

IS : 9507-1979 General purpose electric power driven winches for lifting and hauling.

## C-6. IC-ENGINES

IS : 1602-1960 Code for type testing of variable speed internal combustion engines for automotive purpose

IS : 1603-1960 Performance of variable speed internal combustion engines for automotive purposes

## APPENDIX D

( Clause 9.1 )

The following maximum speeds are recommended for a crane handling its safe working load on a firm level surface.

### TRAVELLING AND SLEWING

<i>Combined Mass of Crane and Safe Working Load, in Tonnes</i>	<i>Up to 10</i>	<i>Over 10 and Up to 20</i>	<i>Over 20 and Up to 30</i>	<i>Over 30 and Up to 40</i>	<i>Over 40</i>
Travelling speed with load km/h	10	8	5	4.5	3
Rate of slewing (revolutions per minute), Mass	3½	3	2½	2	2

**HOISTING AND LOWERING**

<i>Safe Working Load, in Tonnes</i>	<i>Up to 2½</i>	<i>Over 2½ and Up to 4</i>	<i>Over 4 and Up to 6</i>	<i>Over 6 and Up to 10</i>	<i>Over 10 and Up to 15</i>	<i>Over 15 and Up to 25</i>	<i>Over 25</i>
Hoisting speed (metres per minute)	37	27	18.5	14	9	6	4.5

Where a device is used to control the lowering speed it should be arranged to limit the maximum lowering speed with full load to not more than twice the normal full load hoisting speed.

The hoisting and lowering speeds are maximum recommended speeds for normal crane duty, but they may be increased for special duty cranes.

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( Continued from page 2 )

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## BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.  
Telephones: 323 01 31, 323 33 75, 323 94 02

Telegrams: Manaksanstha  
(Common to all offices)

Regional Offices:

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 323 76 17 323 38 41
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	{ 337 84 99, 337 85 61 337 86 26, 337 91 20
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 60 38 43 60 20 25
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